

EXAMINER Peter A. Hruskoci
GROUP 1724
APPLICANT Gurunathan Lakshman
SERIAL NO: 10/522,407
FILED September 29, 2005
FOR HOG MANURE TREATMENT SYSTEM

ATTORNEY DOCKET NO: 85009-202

Commissioner of Patents
Washington, D.C., 20231
U.S.A.

Dear Sir:

Responsive to the Notice of Action dated April 11, 2007:

IN THE SPECIFICATION

At page 1, line 1, please insert the following paragraph:

PRIOR APPLICATION INFORMATION

This application is the National Stage of International Application No. PCT/CA02/01187, filed 7/26/2002.

At page 7, line 16 to page 8, line 13, in the paragraph bridging pages 7 and 8, please insert the following paragraph:

The manure mixture is then transferred to a first reaction tank 18 wherein the mixing speed is reduced to less than 20 rpm and a first coagulating agent is added. In one embodiment, the first coagulating agent is a flocculating or coagulating polymer known in the art, of anionic, cationic or non-ionic type, or a combination of such polymers and polyacrylamides. These coagulating and flocculating agents known in the art are currently used in the flocculation of sewage and other industrial and agricultural effluents. Many of these agents are polymers and/or inorganic chemicals. As will be appreciated by one knowledgeable in the art, examples of coagulating polymers include but are by no means limited to, for example SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide), manufactured by CYTEC, ~~alum~~, WEB-3 or WEB1500. It is of note that other suitable coagulants may also be used. The polymer may be added in a gentle stream, as shown at 20 in Figures 1 and 2. As will be apparent to one knowledgeable in the art, SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide) is viscous and addition thereof must be controlled for optimal results. However, other suitable means known in the art of adding the coagulating agent so that good mixing within the manure mixture is obtained may also be used. As will be appreciated by one knowledgeable in the art, SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide) dosage is determined by the chemical characteristics of the manure to be treated. In some embodiments, the dosing rates can vary from 2 ml per litre to more than 10 ml per litre. SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide) is a solution of SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide) powder in water. It is preferably a 0.25% to 1% solution of SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide) powder in water. Producing a solution of higher concentration may be limited by the high viscosity of the resulting product.

In the paragraph beginning at page 9, line 3 and bridging pages 9 and 10 and ending at page 10, line 5, please insert the following:

The liquid portion in the second reaction tank 20 is mixed with a struvite-promoting compound, for example, MgCl_2 , MgSO_4 , MgCO_3 or magnesium oxide or a coagulant polymer as described above, or combinations thereof. In one embodiment, MgCl_2 , either as a hydrate ($\text{MgCl}_2 \cdot 6 \text{H}_2\text{O}$) or in the anhydrous form is added. At this stage, a second coagulant is also added. In some embodiments, the second coagulant is SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide), which is again added in a gentle stream, as discussed above. It is of note that in addition to or in place of SUPERFLOC, other coagulants may also be used. These include coagulant and flocculant agents known in the art and currently used in the flocculation of sewage and other industrial and agricultural effluents. Many of these agents are polymers and/or inorganic chemicals. When MgCl_2 , in some embodiments, at 1 g per litre to 10 g per litre depending upon the chemical characteristics of the manure, and SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide), in some embodiments, at less than 2 ml per litre to more than 10 ml per litre depending upon the chemical characteristics of the manure, are added to this liquid with continuous mixing, large flocs begin to form due to the formation of struvite, a magnesium-phosphorous compound, which is highly insoluble in water. Thus, this combination of coagulant and struvite-promoting compound has the surprising effect of promoting floc formation to a great extent so that the flocs begin to get denser and precipitate to the bottom. After standing, the liquid portion is again passed through a screening device to separate the settled solids from the liquid portion. Specifically, the solids are removed and/or separated in a mechanical/settling process and the liquid is decanted to the next tank. It is of note that a clear liquid is obtained from this stage of treatment. It is also of note that the liquid may be treated a second time with the struvite-promoting compound(s) as described above, and as shown in Figure 1 wherein the third reaction tank is shown as 22. As will be appreciated by one of skill in the art, the necessity of this additional step will depend on the effluent being treated.

IN THE CLAIMS:

1. (currently amended) A method of treating manure comprising:
 - a) mixing a quantity of manure with lime such that said mixture has a basic pH above 11.0;
 - b) adding a first coagulant to said mixture, thereby promoting floc formation within said mixture;
 - c) separating the floc from the mixture, thereby forming solids and a liquid portion;
 - d) adding a second coagulant and a struvite-promoting compound to said liquid portion, thereby forming solids and clear liquid; and
 - e) separating the clear liquid from the solids.
2. (original) The method according to claim 1 wherein the manure is selected from the group consisting of hog manure, feedlot manure, dairy cow manure and chicken manure.
3. cancelled
4. (currently amended) The method according to claim 1 wherein the basic pH is a pH above 11.5
5. (currently amended) The method according to claim 1 wherein the basic pH is between 11.5-12.5.
6. (original) The method according to claim 1 including removing evolved ammonia during step (a).
7. (original) The method according to claim 6 wherein the ammonia is recovered by bubbling the evolved ammonia into water.
8. (currently amended) The method according to claim 1 wherein the first coagulant is selected from the group consisting of alum and polymer 49A-SUPERFLOC™ C-

496PG Flocculant (cationic polyacrylamide).

9. (currently amended) The method according to claim 1 wherein the second coagulant is selected from the group consisting of alum and ~~polymer-49A~~

SUPERFLOC™ C-496PG Flocculant (cationic polyacrylamide).

10. (original) The method according to claim 1 wherein the struvite-promoting compound is selected from the group consisting of MgCl_2 , MgSO_4 , MgCO_3 and magnesium oxide.

11. cancelled

12. cancelled

13. cancelled

14. cancelled

15. cancelled

16. cancelled

17. cancelled

18. (new) The method according to claim 1 wherein the lime and manure is mixed vigorously for several hours.

19. (new) The method according to claim 1 wherein evolved gases from step (a) are removed under negative pressure.

20. (new) The method according to claim 1 wherein in step (c), the floc is separated from the mixture by mixing the mixture until the floc becomes stable and a layer of clear liquid begins to form at the top of the mixture.

REMARKS:

As the examiner can see, claim 1 has been amended to include the limitations of claim 3 and claim 3 has been cancelled.

Claims 9 and 10 have been amended to refer to SUPERFLOC™. Support for this amendment may be found at least on page 7, line 16 to page 10, line 3 of the application as filed.

Support for new claim 18 may be found at least on page 6, lines 18-22.

Support for new claim 19 may be found at least on page 7, lines 4-6.

Support for new claim 20 may be found at least on page 8, lines 14-20.

As amended, claim 1 is directed to a method of treating manure comprising mixing a quantity of manure with lime such that said mixture has a pH_{above} 11.0; adding a first coagulant to said mixture, thereby promoting floc formation within said mixture; separating the floc from the mixture, thereby forming solids and a liquid portion; adding a second coagulant and a struvite-promoting compound to said liquid portion, thereby forming solids and clear liquid; and separating the clear liquid from the solids.

As discussed in the application as filed and as discussed below, the basic conditions cause gases such as ammonia to be evolved from the manure and also acts to sterilize and deodorize the manure. The first coagulating agent promotes further floc formation and following mixing, separates into floc and liquid portions. A struvite-promoting chemical and a coagulant are then added to the liquid portion which causes further floc formation and the flocs are again separated from the liquid, as discussed at least on page 5, line 5 to page 6, line 8 of the application as filed.

The references to SUPERFLOC and alum on page 8 of the application as filed have been corrected, as discussed above. Support for the amendment regarding

SUPERFLOC is enclosed herewith, specifically, a material safety data sheet from CYTEC which describes the material.

Claims 8, 9 and 11 were rejected under 35 USC 112. It is believed that the amendments to claims 8 and 9 overcome these objections. It is further noted that claim 11 has been cancelled.

Claims 1-10 were rejected under 35 USC 103(a) as unpatentable over Van Slyke (US Patent 6,916,426) in view of Sower (US Patent 6,409,788).

Specifically, the office action states that 'the claims differ from Van Slyke et al. by reciting steps for mixing the manure with lime to produce a basic pH, and adding a second coagulating polymer and/or struvite-promoting compound to a separated liquid portion. Sower disclose ... that it is known in the art to mix manure with lime to produce a pH of about 12, and to utilize flocculants or coagulating polymers, and magnesium salts, to aid in eliminating pathogens, separating suspended solids, and precipitating struvite, respectively. ... With regard to claim 7-9, it is submitted that Sower as applied above, disclose the removal of evolved ammonia using an aqueous solution, and the use of aluminum sulfate, respectively.'

Regarding Van Slyke, the applicant respectfully notes that the polymer is used as the first chemical to the raw waste or waste following an initial solids removal step but the polymer type and dosage are not indicated. The polymer-treated waste is then fed to the separation process and most of the solids separated at this stage. Lime is used in the polymer-treated waste but the pH and dosage are not indicated. The waste is then fed to the solids separator after the lime treatment. Zeolite and H_2SO_4 are added to produce ammonium sulphate and ammonium absorption. In this process, the solids are not disinfected and may contain pathogens. The treated liquid goes through an RO process for pathogen removal.

: Applicant respectfully notes that the sequence of chemicals is different compared to applicant's invention. This makes the type of products at each stage quite

different from applicant's invention. Specifically, polymer treated sludge contains a high dosage of polymer and un-disinfected solids. Furthermore, the specificity of lime use is not indicated in terms of pH which is important because the chemical nature of compounds resulting from the lime treatment depends upon the pH. Zeolite and sulfuric acid used to volatilize and adsorb ammonia and RO-process is required to disinfect the water. Accordingly, different types of liquid and solid products are produced by this process compared to applicant's invention. After the first stage, the liquid will contain almost all of the dissolved phosphorus, nitrogen, potassium and sulfur. After the second stage, the liquid will contain most of the potassium and sulfur. The extent of phosphorus precipitation is not known as the pH rise is not specified. Ammonia is removed in the adsorption stage with the addition of sulfuric acid. Ammonia is removed only in the third stage after all other chemical treatments. Consequently, this process will only remove a fraction of the original ammonia contained in the waste material.

It is further noted that Van Slyke teaches processing the waste 'within a sufficiently short period of time, preferably 12 hours, following the production of the waste material by animals, that the extracted potassium and ammonium-nitrogen remain bound in solid compounds' (US Patent 6,916,426, column 2, lines 45-53). As discussed on at least page 5, lines 19-22 of the instant application, this is contrary to applicant's teachings, wherein '...the manure is combined with lime, resulting in a mixture having a basic pH. The basic conditions cause gases, for example, ammonia to be evolved from the manure, so the mixture is mixed under negative pressure and the gases are drawn off and recovered...'. That is, Van Slyke teaches the need to process the waste before ammonia is evolved as a gas whereas applicant adds sufficient lime at an initial step so that ammonia is evolved.

Regarding Sower, applicant respectfully notes that a first embodiment teaches that zeolite and/or ammonia absorbing materials are fed to the animals through the feed. It is

not known if this process is necessary for the effectiveness of the subsequent parts of the method. A combination of chemicals (precipitating agents, densifiers and flocculants) such as lime, magnesium chloride, zeolite, perlites, crushed limestone, clays, flyash, bentonite and mixtures are added to control the pH and produce flocculation. The liquid routed through lagoons. Solids are processed in a screw-press and the filter cake is dried. This method does NOT specify any dosages or pH ranges. Al chemicals are added at the same time to the waste slurry. The effectiveness of each chemical can be compromised resulting in a product different from the products from applicant's invention. Phosphates, including magnesium ammonium phosphates are recovered by RIM-NUT process. This indicates that the pH rise is not adequate to produce the precipitation of phosphorus. This method calls for additional methods to precipitate phosphorus. Accordingly, this method appears to be a "catch-all" process and includes a combination of several types of chemicals and minerals which are expected to do a number of things to the waste. Furthermore, some of the chemicals may chelate others.

In another embodiment, Sower teaches adding magnesium salt prior to the lime addition and flocculant is added as the last step as is a clarifier-thickener. Once again, the products are different from the products from the instant invention. The entire mixture of the waste with the chemicals at various stages is transferred from one tank to another. This is equivalent to adding the chemicals at the same time as the solids are not separated before transferring the entire mixture to the final clarifier/thickener. The method does not show that changing the sequence of chemicals is an option. In other words, the sequence of chemicals and the way they are added are essential for achieving the results.

In another embodiment, Sower teaches that zeolite is added to the waste followed by $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, lime and flocculant. The description of the approach does not show

that changing the sequence is an option. It appears that zeolite is necessary for the other chemicals to be effective

In another embodiment, Sower teaches that magnesium salt is added first. The entire mixture is transferred to a second tank and lime is added. Ammonia is volatilized in H_2SO_4 and the mixture is passed to a thickener. This is similar to the previous method without the Zeolite addition.

It is further noted that at column 30, lines 1-6 Sower in fact states 'preferably, the organic waste is mixed first with a magnesium salt such as magnesium chloride or magnesium sulfate because if the organic waste were mixed first with lime, a significant amount of phosphate ions would combine with calcium ions, thus becoming unavailable to form magnesium ammonium phosphate.' Thus, Sower specifically teaches against the addition of lime alone first as taught by applicant. Specifically, Sower teaches the addition of a magnesium salt first followed by the addition of lime to initiate struvite formation, which is not applicant's invention, wherein lime is added first and struvite formation is carried out in a later step. It is further noted that the addition of lime prior to the addition of a magnesium salt is expressly taught against by Sower, as discussed herein

As the examiner can see, all of these methods employ the same sequence of chemicals. The differences are due to the addition of zeolite, ammonia volatilization and the inclusion of digester. The chemicals are always done in the sequence (1) magnesium salt (2) lime and (3) flocculant, indicating that Sower requires the addition of chemicals in the same order as a necessary part of the invention.

Both Van Slyke and Sower use lime only after the addition of other chemicals and minerals such as flyash, zeolite, etc. Particularly, Sower does not use lime as the first chemical in any of his methods. In all his methods lime is used only after the pre-treatment of the waste is accomplished using other chemicals or minerals. Nowhere does he even suggest

the use of lime as the first chemical. The fact that all his methods are comprised of various combinations of chemicals in different sequences but never use lime as the first chemical clearly shows he particularly excludes the use of lime as the first chemical.

Furthermore, Sower's methods are not specific in terms of what is achieved at each stage of chemical addition and the purpose of the specific chemical used. The range of pH is not critical to most of the methods. Consequently, the waste material treated is substantially different compared to applicant's method.

Accordingly, it is held that it is not possible for anyone of skill in the art to combine the two references and come up with applicant's method, as both references preclude the use of lime as the first chemical. Specifically, combining Van Slyke with Sower teaches the addition of an additional struvite removal step wherein a struvite formation-promoting magnesium salt is added followed by the addition of lime. Sower teaches that lime cannot be added prior to the magnesium salt or 'phosphate ions will combine with calcium ions, thus becoming unavailable to form magnesium ammonium phosphate'. As discussed herein, that is not applicant's invention.

Specifically, in applicant's invention, waste is directly used in the treatment process without any pre-treatment. The objectives of the process are to, i) remove solids, ii) remove pathogens iii) remove odor, iv) remove ammonia, v) remove phosphorus, vi) remove nitrogen, vi) remove sulfur and potassium. These are accomplished in a systematic and sequential manner in the sequence mentioned above and as discussed on pages 5-10 of the application as filed.

First stage: Lime is added to raise the pH sufficiently (to above 11.0) to produce insoluble phosphorus compounds such as hydroxyapatite, beta-tricalciumphosphate or magnesium-calcium phosphate depending upon the pH and the presence of specific metal ions. The increase in the pH is ensured to be high enough to kill all pathogens by 'Chemical

Pasteurization'. High pH induces rapid precipitation of chemical complexes and solids producing readily settleable solids. The rise in pH converts H_2S (gas) into H_2S ion. This removes most of the odor during the first reaction. Bacterial activity and hence the production of odorous gases are reduced to a minimum due to the increase in pH. Preliminary flocs are created and the manure becomes readily settle-able at this stage.

Second Stage: At this stage a flocculant is added to speed up the formation of larger flocs and the settling process. The purpose of the flocculant is only to create larger flocs and settle the solids rapidly.

Third Stage: The sludge from the treated manure is removed and the supernatant is pumped to the next stage

Fourth Stage: Magnesium chloride is added with the specific purpose of reacting with the soluble phosphorus and nitrogen not removed in the previous stages to form insoluble struvite. The insoluble struvite coagulates with the insoluble solids not removed in the previous filtration process and produces larger flocs which are then removed by screening/ filtration.


Fifth Stage: The clear water from the previous stage is pumped through an upflow reactor containing activated carbon to remove dissolved gases and dissolved BOD

The above process is distinctly different from either Van Slyke's or Sower's process in the way the treatment sequence is built up to remove various contaminants and pathogens in a systematic manner. The function of each of the chemicals used is specific. The sequence of chemicals is important to produce a 'synergistic' effect for a very effective treatment process.

Further and more favorable consideration is respectfully requested.

Respectfully submitted

GURUNATHAN LAKSHMAN

PER: 
Michael R. Williams
Registration # 45,333

August 10, 2007
Enc.()

Winnipeg, Manitoba, Canada
Telephone (204) 947-1429 - FAX (204) 942-5723



MSDS: 0010953
Date: 01/04/2006
Supersedes: 11/12/2001

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: SUPERFLOC® C-496PG Flocculant
Synonyms: None
Chemical Family: Cationic Polyacrylamide
Molecular Formula: Polymer
Molecular Weight: Polymer

CYTEC INDUSTRIES INC., FIVE GARRET MOUNTAIN PLAZA, WEST PATERSON, NEW JERSEY 07424, USA

For Product Information call 1-800/652-6013. Outside the USA and Canada call 1-973/357-3193.

EMERGENCY PHONE: For emergency involving spill, leak, fire, exposure or accident call CHEMTREC: 1-800/424-9300. Outside the USA and Canada call 1-703/527-3887.

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2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA REGULATED COMPONENTS

Component / CAS No.	% (w/w)	OSHA (PEL):	ACGIH (TLV)	Carcinogen
Adipic acid 124-04-9	~ 4.5	Not established	5 mg/m ³ (TWA)	-

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE AND ODOR:

Color:	off white
Appearance:	crystalline powder
Odor:	odorless

STATEMENTS OF HAZARD:

CAUTION! MAY CAUSE EYE AND SKIN IRRITATION

POTENTIAL HEALTH EFFECTS

EFFECTS OF EXPOSURE:

The estimated acute oral (rat) LD50, acute dermal (rabbit) LD50 and 4-hour inhalation (rat) LC50 values for this material are >5,000 mg/kg, >2,000 mg/kg and >20 mg/L, respectively. Direct contact with this material may cause mild eye and skin irritation. Refer to Section 11 for toxicology information on the regulated components of this product.